



Innovative Ground & Small Spacecraft Operations

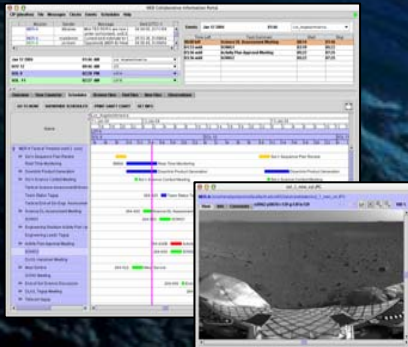
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MER Mission Ops Tools



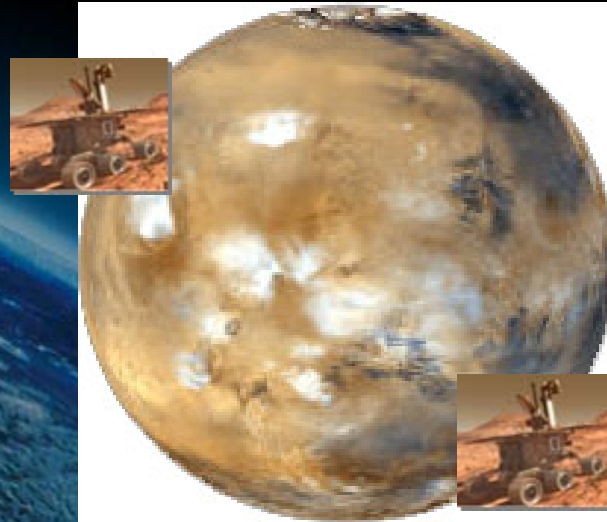
MAPGEN: Activity plan development and analysis



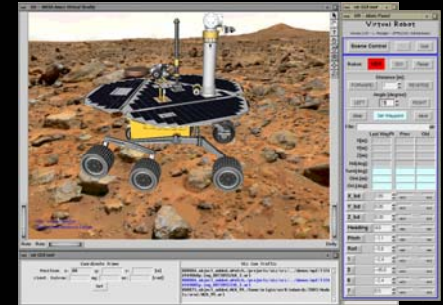
CIP: Customizable data navigation, search, and information management

All Software has been continuously operational for the Entire mission to date

MER science and uplink team members have estimated that overall science return increased by 20 - 50%.



MERBoard: Collaborative information analysis and sharing



Viz: High fidelity terrain modeling and analysis

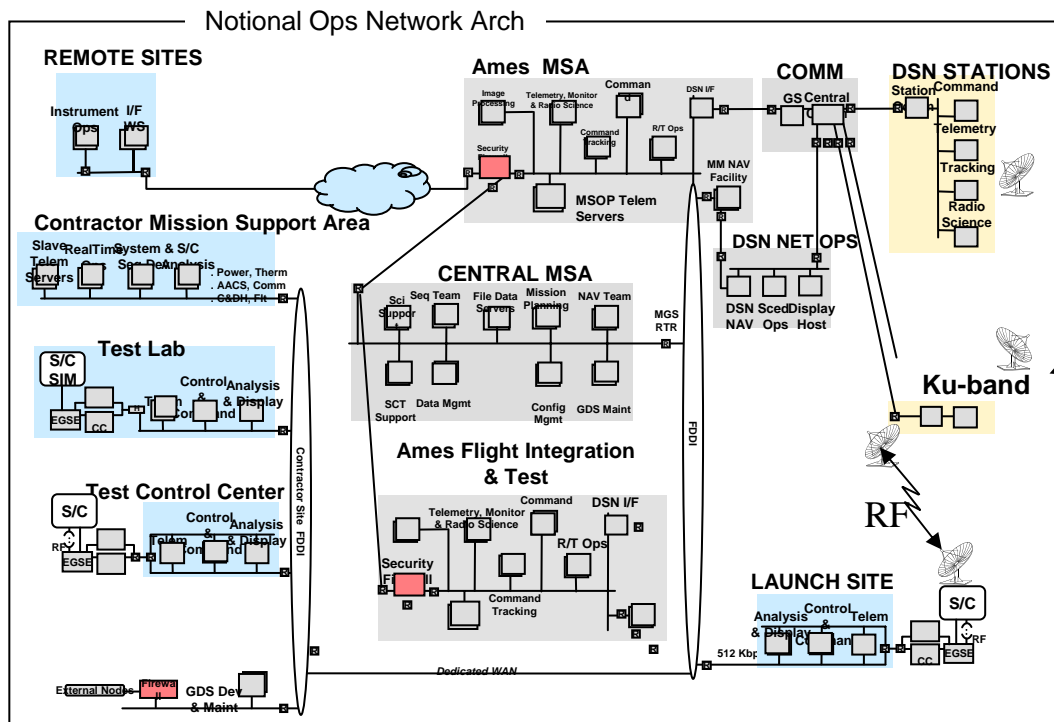


HCC & Fatigue Countermeasures: Improved data understanding and Enhanced situational awareness



Mission Operations Elements

1. First 'Day' of operations using Ground-based Ops
2. DSN and Direct Ku-Band available for up and down
3. Transition to Lights Out Automation for Engineering Monitoring and Goal-based Science



QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Desire to Baseline Lights Out Automation



TAZ Fully Deployable Satellite Dish

- TAZ Specifications
 - 2.8 Meter Deployable KU Band Satellite Dish
 - 10 Deployable weatherproof Cases
 - Maximum bandwidth capacity(current modem is the limiting factor)
 - Approximately 5Mbps (Satellites capacity is 45Mbps) Down
 - Approximately 1.8Mbps Up





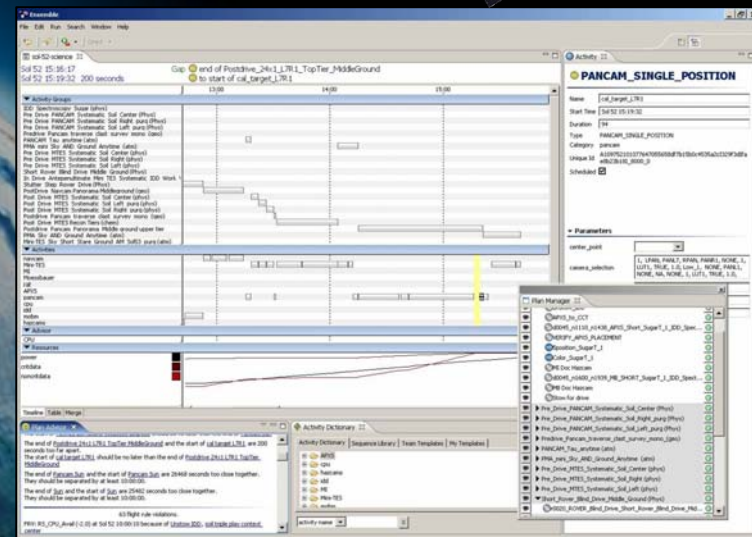
Advanced Mission Operations Systems

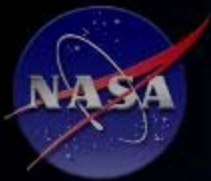
Scope: Ensemble/MCT are open platforms for the development, integration, and deployment of mission operations software based upon the Eclipse IDE. Java-based Eclipse IDE is an open source platform for Tool development.

- Multiple teams from various NASA centers developing Eclipse plug-ins and extensions (ARC, JPL, etc)

Deliverables

- Deliver first wave of baseline mission tools based on Eclipse RCP (opensource Java IDE)
 - MER downlink analysis tools (JPL/Ames)
 - Phoenix Science Interface (Ames/JPL)
- Integrate existing additional tools with near-term mission pull
 - Viz 3d visualization environment
 - GIS based system (Worldwind)
- Extend tools for later missions such as Small Sats
 - Distributed planning and scheduling
 - Remote telemetry display and analysis
 - Model-based diagnosis systems





Ensemble Project

Ames Human System Integration, and Intelligent Systems Divisions, and JPL's Division 31 all jointly developing tools

Compatible Ensemble Ops Components

Search for:
Any data products acquired from Sols 561 to 586

Pancam Sol 561
Sequence Id: p2600 Site 113 / Position 80

Navcam Sol 561
Sequence Id: p1585 Site 113 / Position 80

Duration	Energy	Critical Data	Total Data
13:46:30	1.99 MWh	10.5 Mb	10.5 Mb
00:06:53	13.13 kWh	< 1 Mb	10.0 Mb
00:06:53	13.13 kWh	< 1 Mb	10.0 Mb
00:05:00	9.74 kWh	-0-	3.2 Mb

Distance start of Trench_Center
to start of Penultimate front hazcam

Activities

- navcam
- headers
- Mossbauer
- APRS
- cpu
- mobm
- gna
- hqa
- Mini-TES
- HT
- rat
- pancam
- img
- dyn
- ids
- hazcams

MER 2006: In Use



Phoenix 2007: Delivered



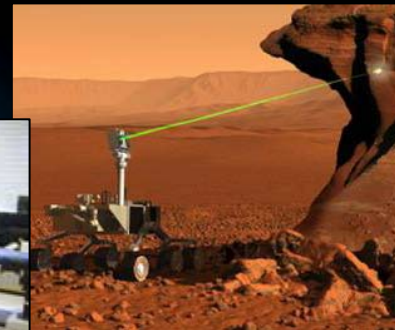
New Opportunities

Ames Small Satellites etc

JSC Bed Rest



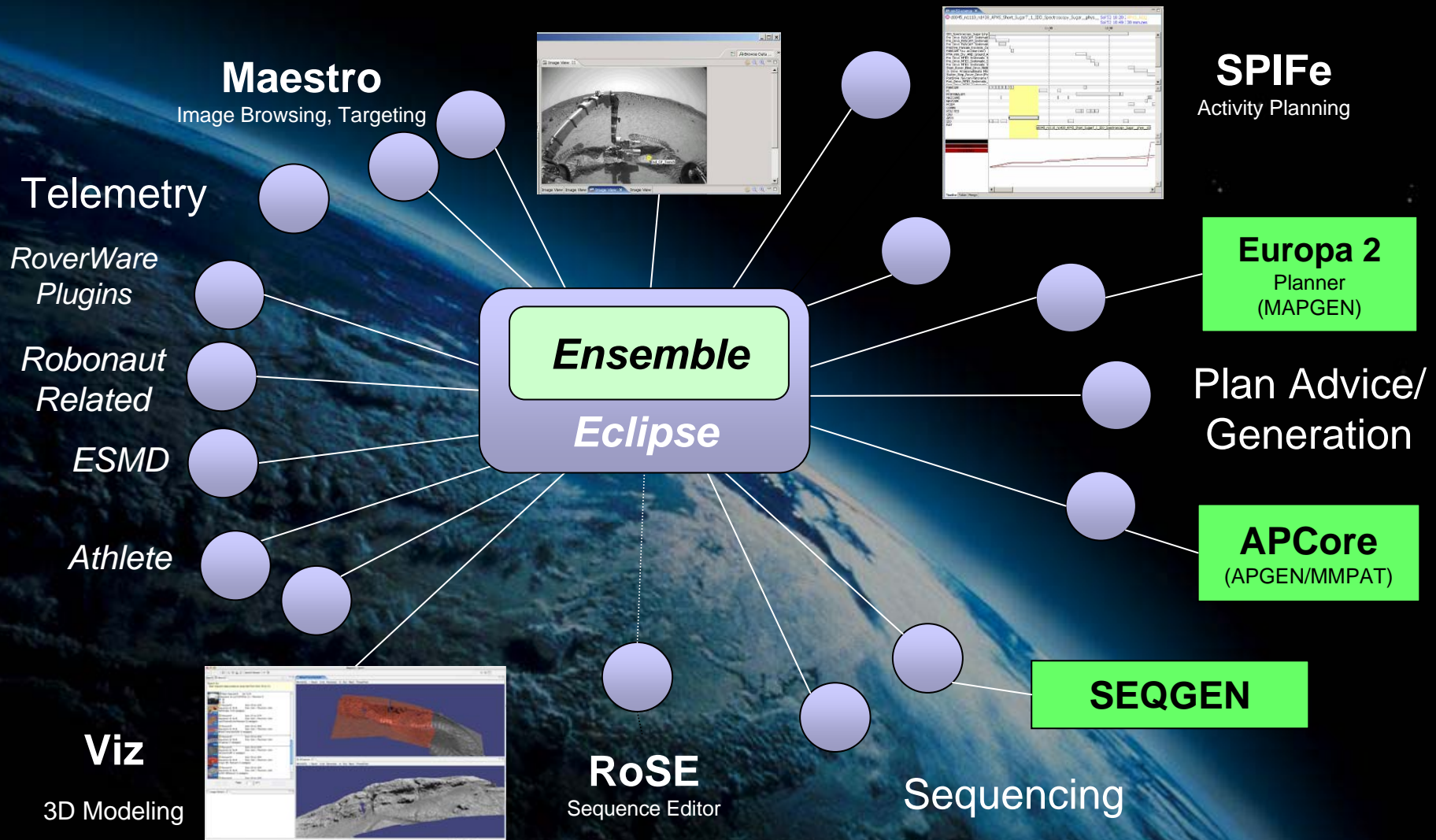
MSL 2009: Baseline

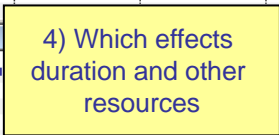




Broad Participation of Toolkits

We can bring many existing tools to mission operations, reducing risk and cost.



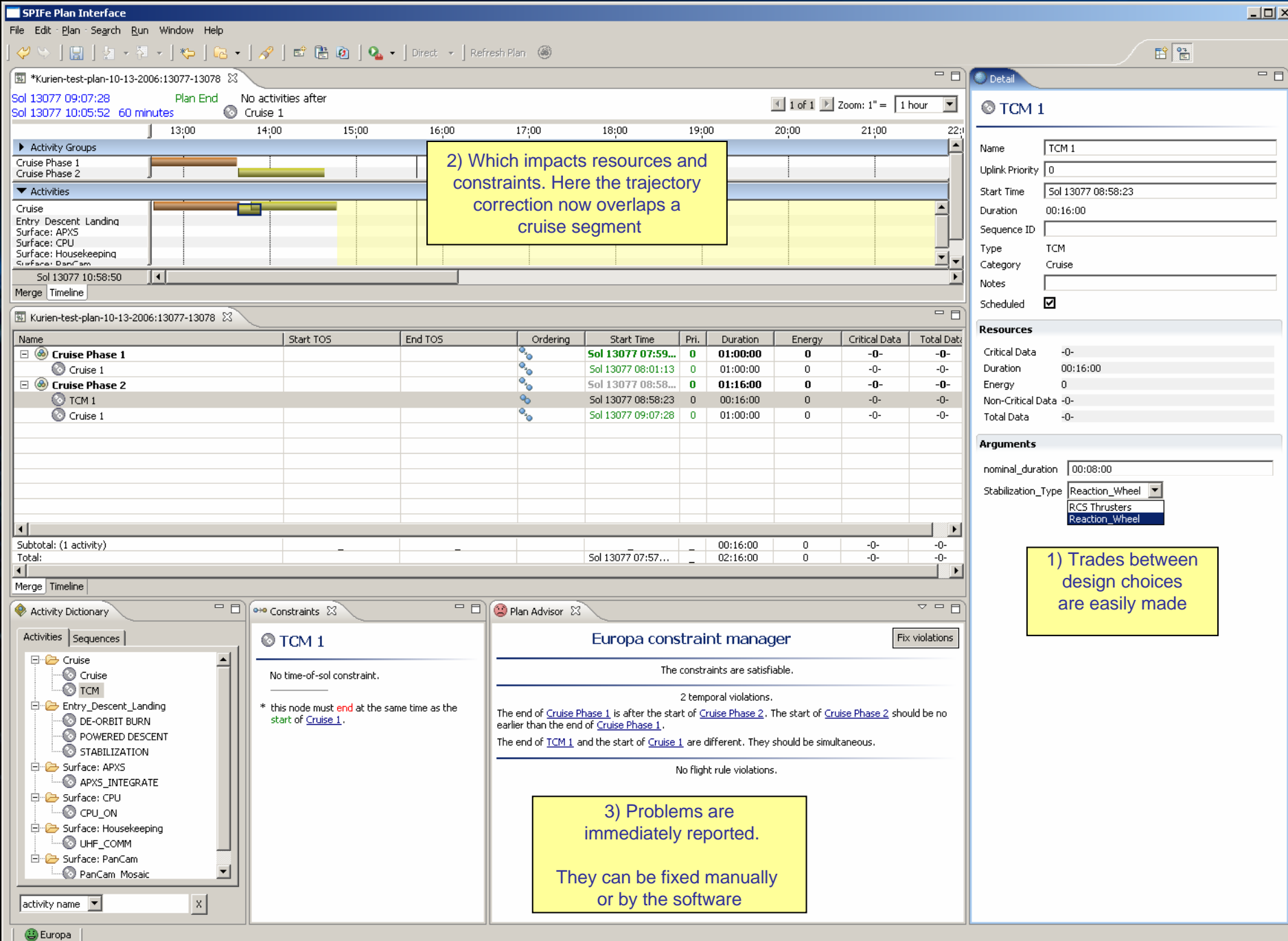


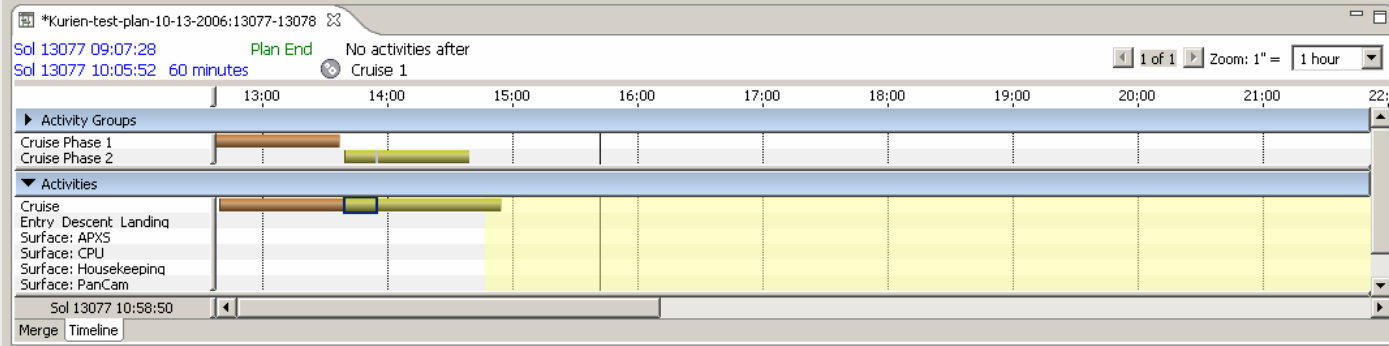
1) We create activities by dragging them to the worksheet

3) We set parameters of the activity

2) We can capture constraints between activities

Fix violations





Kurien-test-plan-10-13-2006:13077-13078

Name	Start TOS	End TOS	Ordering	Start Time	Pri.	Duration	Energy	Critical Data	Total Data
Cruise Phase 1									
Cruise 1				Sol 13077 07:59...	0	01:00:00	0	-0-	-0-
Cruise Phase 2									
TCM 1				Sol 13077 08:01:13	0	01:00:00	0	-0-	-0-
Cruise 1				Sol 13077 08:59:36	0	00:16:00	0	-0-	-0-
Cruise 1				Sol 13077 09:15:11	0	01:00:00	0	-0-	-0-
Subtotal: (1 activity)						00:16:00	0	-0-	-0-
Total:				Sol 13077 07:57...		02:16:00	0	-0-	-0-

Merge Timeline

Detail

TCM 1

Name TCM 1

Uplink Priority 0

Start Time Sol 13077 08:59:36

Duration 00:16:00

Sequence ID

Type TCM

Category Cruise

Notes

Scheduled ☒

Resources

Critical Data -0-

Duration 00:16:00

Energy 0

Non-Critical Data -0-

Total Data -0-

Arguments

nominal_duration 00:08:00

Stabilization_Type Reaction_Wheel

- Activity Dictionary
- Activities Sequences
- Cruise
 - Cruise
 - TCM
 - Entry_Descent_Landing
 - DE-ORBIT BURN
 - POWERED DESCENT
 - STABILIZATION
 - Surface: APXS
 - APXS_INTEGRATE
 - Surface: CPU
 - CPU_ON
 - Surface: Housekeeping
 - UHF_COMM
 - Surface: PanCam
 - PanCam Mosaic
- activity name

Constraints

TCM 1

No time-of-sol constraint.

* this node must end at the same time as the start of Cruise 1.

Plan Advisor

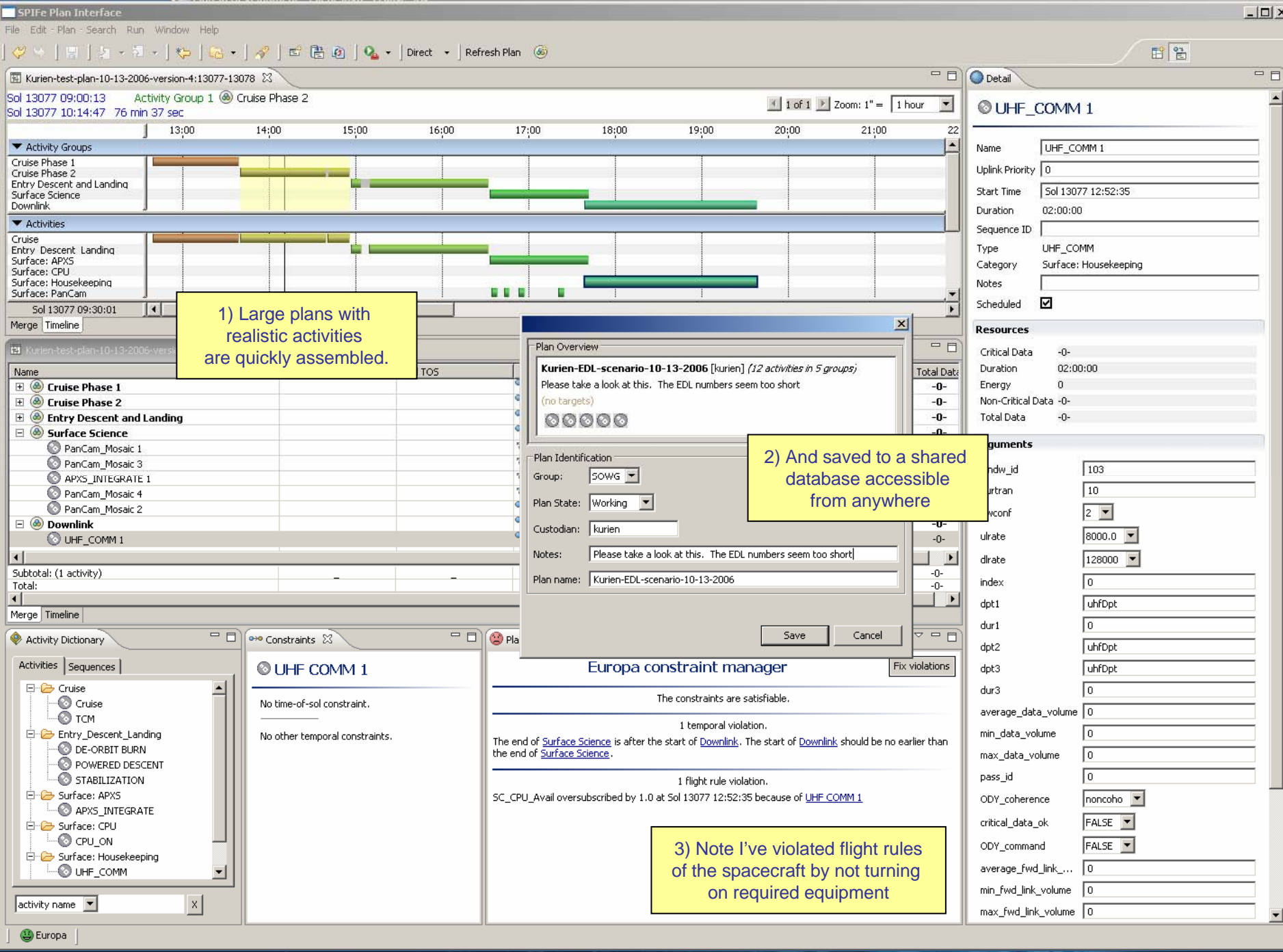
Europa constraint manager

Fix violations

The constraints are satisfiable.

No temporal violations.

No flight rule violations.



1) Large plans with realistic activities are quickly assembled.

2) And saved to a shared database accessible from anywhere

3) Note I've violated flight rules of the spacecraft by not turning on required equipment



Questions?